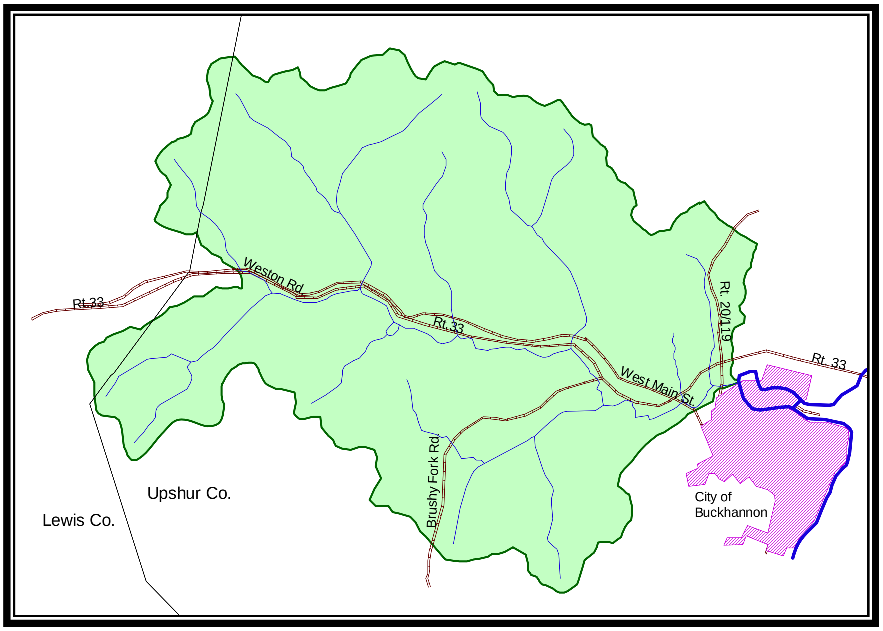
WATERSHED-BASED IMPLEMENTATION PLAN FOR FINK RUN, WV



Prepared by:

The Highlands Institute for Environmental Research and Education

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Introduction

"Fink Run (WVMTB-11) rises two miles northwest of Lorentz in Lewis County at an elevation of 1,540 feet. It flows southeastward through Upshur County and empties into the Buckhannon River at Buckhannon at an elevation of 1,390 feet. This is a generally placid stream. It is 6.5 miles long and has an average fall of 23 feet per mile. . . The mean annual precipitation of this watershed is approximately 44 inches. The highest elevation in the watershed is approximately 1,600 feet. The lowest elevation is approximately 1,390 feet. The drainage area is about [16.0] square miles or [10,163] acres" (WV DEP 2000). The City of Buckhannon is adjacent to Fink Run and has recently annexed small portions of Fink Run watershed (Figure 1).

The three dominant water quality problems within the watershed are metals, sediment, and fecal bacteria. The main sources of these contaminants are coal mining, agriculture, logging, and oil and gas well roads. This plan will elucidate the sources of contamination and describe the steps that will need to be taken to achieve load reductions in metals, sediment, and fecal bacteria due to non-point sources; permitted sources of pollution will not be addressed. This report was prepared by The Highlands Institute for Environmental Research and Education at West Virginia Wesleyan College for the Buckhannon Framework Steering Committee and the WV Department of Environmental Protection.

A. Causes and Sources of Non-Point Source Pollution

A.1 Geographic Extent

The population density in Fink Run Watershed is about 1,120 (WV DEP 2000) which yields a low population density. Over half of the land in the watershed is forested and about one-third is used for agriculture, mainly pasture. More details can be found in Table 1. The percent of urban land is listed as 2.5%; however, in the past ten years since the land use information was gathered, there has been rapid "urban sprawl" from the nearby city of Buckhannon especially along the four-lane Rt. 33. This has led to conversion of about 40 acres of wetlands, forest, and agriculture land to urban which would increase the urban percentage to approximately 2.9% with concomitant reductions in the other categories. For the purposes of this report Fink Run Watershed was divided into ten subwatersheds: Lower Fink, Tributary 1, Leggett, Mudlick, Wash, Bridge, Sauls, Brushy Fork, Tributary 2, and Upper Fink (Figure 2).

Table 1. Land use in the Fink Run Watershed according to 1993 GIS land use coverage (WV DEP 2000).

LAND USE	ACRES	%
Forested	6,027	59.3
Agriculture	3,791	37.3
Urban	254	2.5[a]
Barren	20	0.2
Strip Mine	30	0.3
Waters/Wetland	41	0.4
TOTAL	**10,163**	**100.0**

Table 2. Subwatershed names, areas, and stream miles for Fink Run Watershed based on 2003 GIS DRG maps (see Figure 2).

Subwatershed Name	Area *(acres)*	Stream Miles *(mi)*
Lower Fink	1,164	3.24
Tributary 1	543	1.27
Leggett	251	0.63
Mudlick	1,516	3.70
Brushy Fork	2,183	4.44
Wash	553	1.73
Tributary 2	497	1.08
Bridge	1,641	3.70
Sauls	869	2.80
Upper Fink	973	3.38
Total	**10,190**	**26.0**

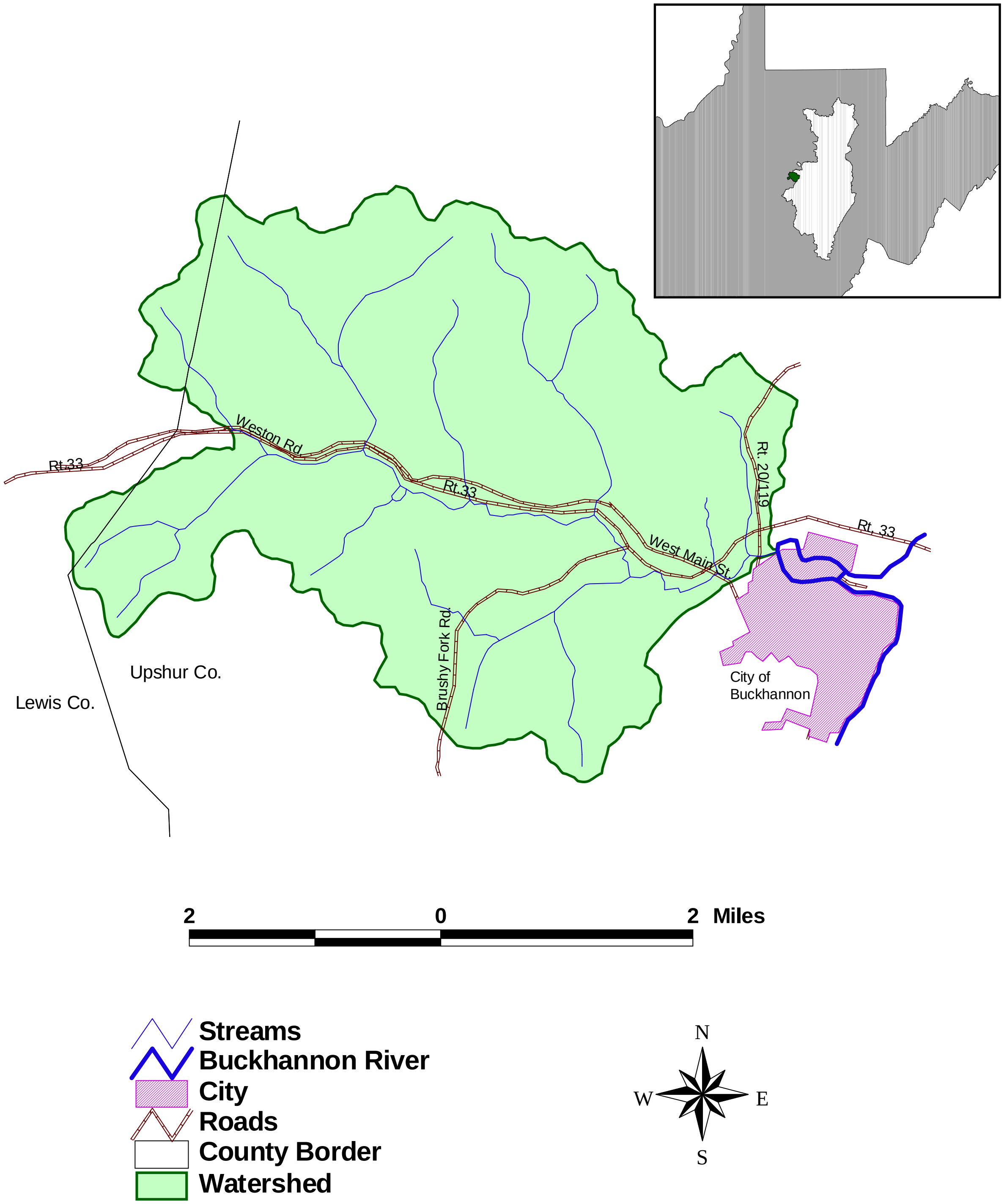


Figure 1. Map of Fink Run watershed showing the watershed boundary, streams, roads and county boundaries.

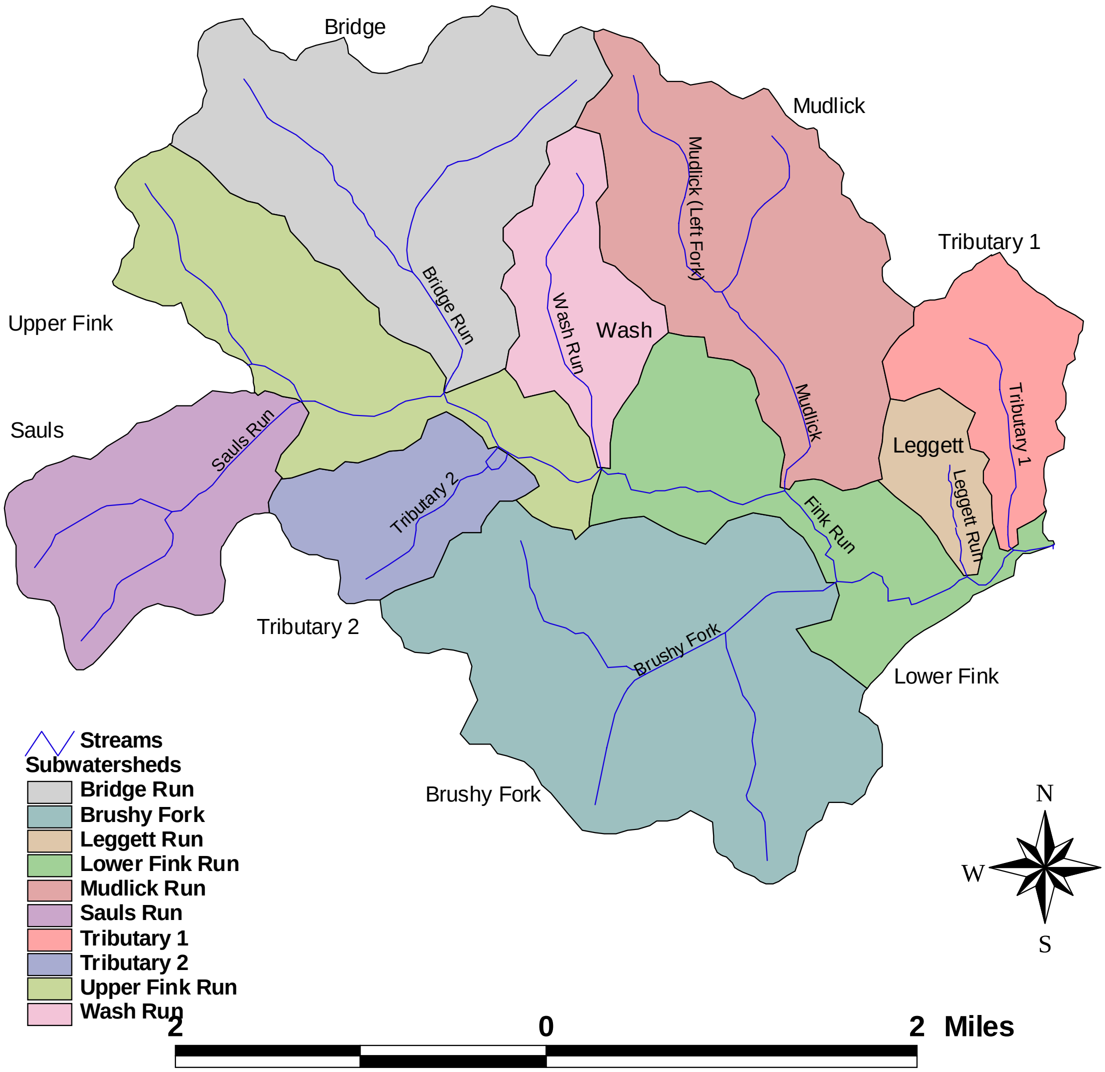


Figure 2. Map of Fink Run watershed showing the ten subwatersheds and stream names.

A.2. Measurable Water Quality Goals for Fink Run

Metals: Achieve load reductions in iron, manganese, and aluminum to achieve 100% compliance with state water quality criteria in all streams in the watershed through load reductions and mitigation strategies. In B-1 and B-2 waters the iron criteria are 1.5 and 0.5 mg L^{-1}, respectively. For aluminum the criterion is 0.75 mg L^{-1}. The human health criterion for manganese is 1.0 mg L^{-1} (WV SS 2004).

Sediment: There are no state water quality criteria for sediment and there is little information available on sediment loads in the watershed so a water quality goal cannot be established. However, sediment sources can be quantified. Our goal is for 100% of stream miles in the watershed to achieve a Habitat Score of 180 or greater using the Rapid Habitat Assessment (RHA) Index (WV SOS 2004).

Fecal Bacteria: Reduce loads and/or mitigate surface water to achieve 100% compliance with state water quality criteria for fecal coliform in all streams in the watershed. The state maximum contaminant level for fecal coliform for recreational waters is 200 CFU per 100 ml as a monthly geometric mean based on not less than 5 samples per month or 400 CFU per 100 ml in more than ten percent of all samples taken during the month.

Biological Integrity: Most of the pollutants listed above have a negative impact on the biota of streams. To ensure that the biological integrity of streams is being preserved and maintained, biological assessments of streams should be conducted. These biological assessments of fish and benthic macroinvertebrate diversity and abundance answer the ultimate question, "Is overall water quality good enough to support a viable stream community?" Furthermore, bioassessments complement point-in-time chemical sampling because they are time-integrated measures of water quality. The goal here is a rating of 68% or better on the WV Stream Condition Index (WVSCI) for all streams in the watershed.

A.3. Causes and Sources of Pollution

In this section of the report we attempt to quantify the sources of contaminants. This is a challenging undertaking because the data were collected by diverse federal, state, and local agencies. Nonetheless we are confident we have gathered together all of the most recent and most relevant data that exist for this watershed.

A.3.a. Metals

The main source of metals in the watershed is acid mine drainage (AMD) from abandoned mines (raw AMD) and possibly from inactive, reclaimed mines or permitted mines. Three streams in the watershed were listed as impaired on the state's 1998 303(d) list yielding a total of 12.5 miles of impacted streams out of a total of 26.0 miles in the watershed.

Table 3. Streams impaired by acid mine drainage (metals and pH) according to the 1998 303(d) list.

Stream Name	**Stream Miles Affected**
Fink Run (WVMTB-11)	8.17
Mudlick Run (WVMTB-11-B)	1.90
Bridge Run (WVMTB-11-B.7	2.47
Total	**12.54**

Chemical sampling by the Stream Restoration Group (WV DEP) and The Highlands Institute at West Virginia Wesleyan College has documented several other streams that appear to violate water quality standards for metals, although the number of samples taken in most cases is small (see Table 4). Nine stream reaches comprising a total of 16.8 miles had high metal concentrations which were indicative of AMD contamination. These streams were distributed throughout seven of the ten subwatersheds.

Table 4. Measured water quality parameters for select streams in the Fink Run Watershed divided by subwatershed. Samples were collected by West Virginia Wesleyan College's Environmental Laboratory and the WV Stream Restoration Group between 1997 and 2002. Only those samples with Fe and Al concentrations greater than 0.5 and 0.75, respectively, are presented. This list represents the potential sources of metal loads in the Fink Run watershed. Asterisks denote streams that are listed on the state's 303(d) list. Bold values exceed state water quality criteria.

Site Description	Sub-watershed	Collected Yr.	Collected Mon	Collected Day	Field Cond *(uS/cm)*	Field pH	Total Acidity *(mg/L)*	Total Fe *(mg/L)*	Total Mn *(mg/L)*	Total Al *(mg/L)*	Stream Miles *(mi)*
Fink Run downstream of Bridge Run	Upper Fink	2002	5	6	256	6.85	3	**1.31**	0	0.13	1.6
Mudlick Run at mouth	Mudlick	2002	5	6	234	6.67	6	**4.56**	0.63	0.36	2.0
Mudlick Run near headwaters	Mudlick	2002	5	6	361	7.27	1	**0.78**	0.25	0.28	2.2
Leggett Run at mouth	Leggett	2002	5	6	94	7.45	3	**1.12**	0.13	**1.15**	0.6
Tributary 2 at mouth	Trib 2	2002	5	6	71	7.24	2	**0.93**	**1.16**	0.68	1.5
Bridge Run at mouth	Bridge	2001	10	15	232	6.96	6	**5.51**	0.74	0.54	1.2
Trib. 2 of Bridge Run	Bridge	2001	10	15	109	7.12	4	**1.72**	0.13	**1.47**	1.7
Brushy Fork at mouth	Brushy Fork	2001	10	15	191	7.00	8	**0.85**	0	**0.93**	1.9
Fink Run at mouth	Lower Fink	2004	6	20	285	7.15	2	**1.26**	0.43	0.46	4.1
										Total Miles:	**16.8**

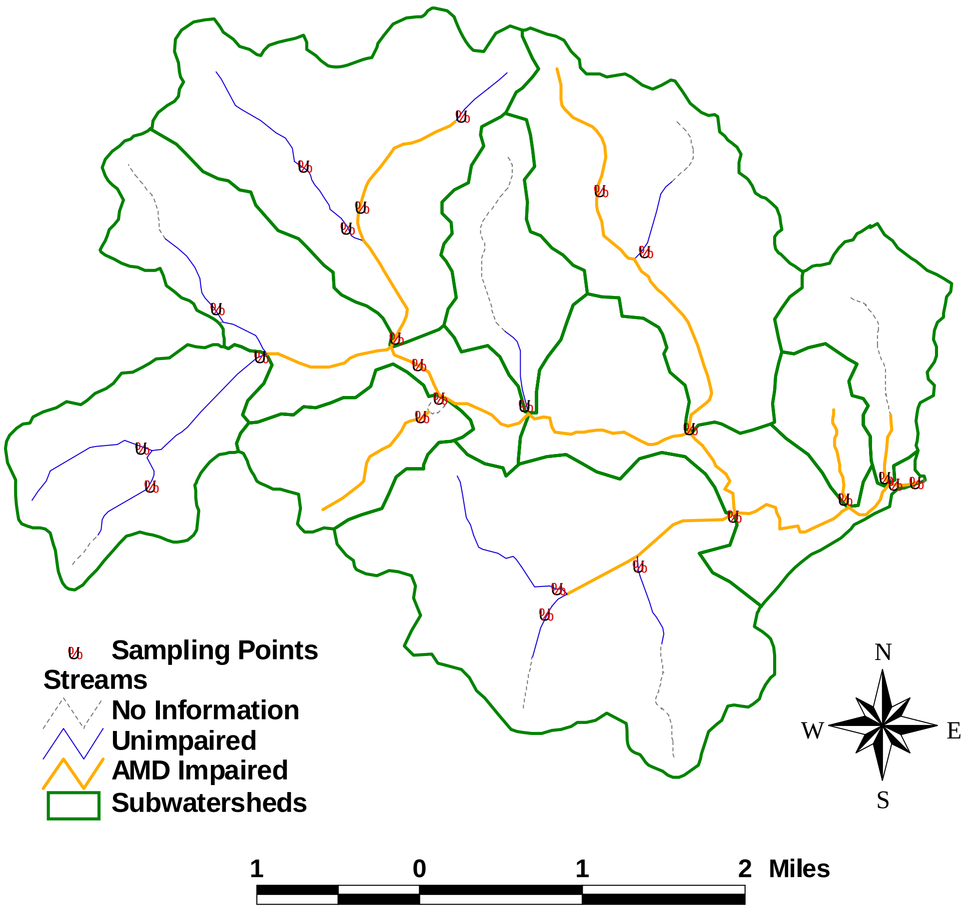


Figure 3. Map of Fink Run showing AMD-impaired streams (thick, orange lines) according to stream chemistry data from 2001-02 (see Table 4). Unimpaired streams (thin, blue lines) and streams that were not sampled (gray, dotted lines) are also shown. Sampling locations are portrayed as squares.

GIS files from the WV DEP show only two mining permits in Fink Run watershed with a total area of 122 acres (Table 5; Figure 4). One of the permits is completely Released and is located in Mudlick subwatershed. The other contains three properties that are in Phase 2 Release and drain into Brushy Fork, Tributary 2, and Upper Fink subwatersheds.

Table 5. List of mining permits within Fink Run watershed according to WV DEP GIS shape files.

ID No.	Area (ac)	Permit Number	Status	Subwatershed
1	46	s202887	Released	Mudlick
2	76	s003984	P2 Release	Brushy Fork, Trib. 2, Upper Fink
Total	**122**			

Fourteen abandoned mine land (AML) Problem Areas and one bond forfeiture site are recorded within Fink Run watershed (Table 6; Figure 4; WV DEP 2000). These are located in Lower Fink, Leggett, Mudlick, Wash, and Bridge subwatersheds. Most of these sites are not closely monitored so it is possible that AMD is being contributed to surface water from some of these sites.

Table 6. List of abandoned mine land sites (AML) within the Fink Run watershed according to WV DEP GIS shape files.

ID No.	Priority	PAD Number	ID No.	Priority	PAD Number
1	1	0315	8	3	2903
2	1	0316	9	1	4151
3	2	0317	10	2	4672
4	2	0851	11	2	4673
5	3	2751	12	2	4950
6	3	2752	13	2	4986
7	3	2755	14	2	5265

Two AML sites have been investigated closely as part of pre-project monitoring by the WV Office of Abandoned Mine Lands and Reclamation. Mudlick Refuse is an AML problem area that has exposed coal waste and a few discharge pipes that are leaking AMD. Discharge from the site has pH values ranging from 2.8 to 4.3 and iron concentrations as high as 43 mg L^{-1} (Table 7).

Bridge Run Refuse is another AML problem area that is leaching AMD. Effluent from this site is acidic (pH 4 to 6) and has high iron concentrations (up to 49.2 mg L^{-1}). These two AML sites are responsible for a substantial portion of the metal loads to Fink Run.

Table 7. Water chemistry data from two AML sites in Fink Run watershed – Mudlick Refuse (WVPAD# 5265) and Bridge Run Refuse (WVPAD# 4950). Data were collected 18 December 2002. Aluminum was analyzed only at one site.

Site Description	Sub-watershed	Field Cond (*μmho*)	Field pH	Total Acidity (*mg L^{-1}*)	Total Fe (*mg L^{-1}*)	Total Mn (*mg L^{-1}*)	Total Al (*mg L^{-1}*)
Mudlick Refuse seep	Mudlick	993	3.3	330	**140**	**11.1**	--
Mudlick Refuse pipe discharge 1	Mudlick	67	3.6	20	**0.9**	0.4	--
Mudlick Refuse pipe discharge 2	Mudlick	828	2.8	179	**42.9**	1.0	--
Mudlick Refuse pipe discharge 3	Mudlick	91	4.3	11	**4.8**	0.1	--
Bridge Run Refuse discharge	Bridge	69	5.3	0	**1.9**	0.1	--
Bridge Run Refuse discharge OLC	Bridge	676	3.3	149	**49.2**	**3.4**	**7.1**

In summary, elevated metal concentrations have been found in Mudlick Run, Leggett Run, Tributary 2, Bridge Run, and Brushy Fork. The high metal concentrations in Lower and Upper Fink Run are probably derived from the tributaries since there are no AML sites or mines adjacent to the main stem.

The active mines are permitted and so do not fall into the non-point source category. The permitted operations are most likely responsible for the high metal concentrations in Tributary 2 and Brushy Fork subwatersheds since there are no AML sites in those watersheds (and just one bond forfeiture site in Tributary 2). Therefore, we can ignore the loads contributed by these two subwatersheds since they are permitted point sources. The permitted site in Mudlick subwatershed is completely reclaimed and should not be discharging AMD. Reclamation efforts should focus on Mudlick, Leggett, and Bridge subwatersheds.

The elevated metal concentrations in Mudlick Run, Leggett Run, and Bridge Run must be from AML sites since there are no permitted operations in these subwatersheds. Table 8 shows estimated loads of metals for each subwatershed and their attributed source. The largest contributions of iron to Fink Run come from Mudlick and Bridge subwatersheds. Mudlick and Bridge were also the main sources of manganese. The largest contributions of aluminum come from Brushy Fork and Mudlick. Leggett contributes relatively small loads and so is a low priority.

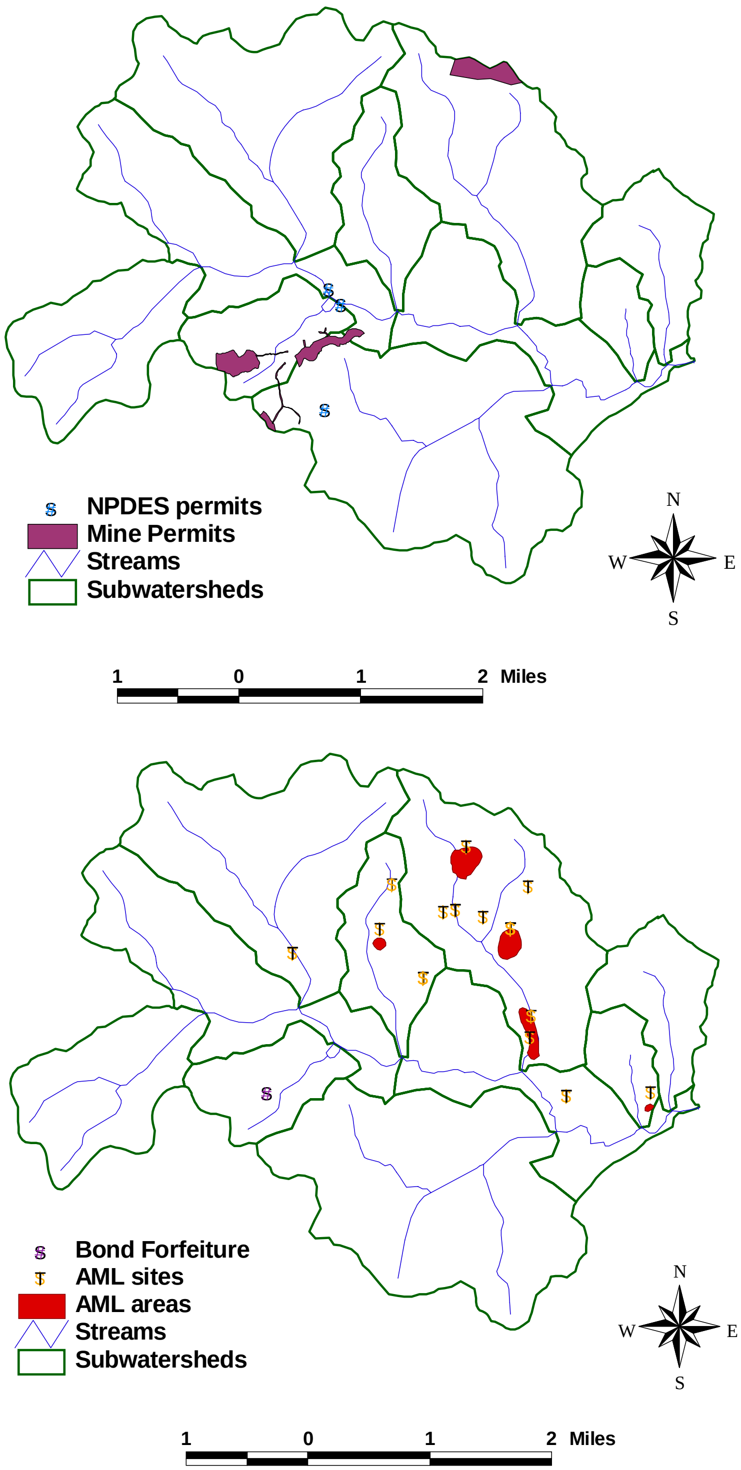


Figure 4. Maps of Fink Run watershed showing areas of current mining permits and NPDES discharges (upper) and locations of AML problem areas and bond forfeiture mine sites (lower).

Table 8. Calculated loads of metals for Fink Run subwatersheds. Calculations are based on only two stream sampling dates (see Appendix for calculations). "Others" was calculated as the difference between the "Fink at Mouth" load and the sum of the subwatershed loads and represents other sources of metals as well as in-stream processes such as precipitation reactions. The data in parentheses pertain to specific AML sources and are not used to calculate column totals.

Subwatershed	**Iron** *(lbs yr^{-1})*	**Manganese** *(lbs yr^{-1})*	**Aluminum** *(lbs yr^{-1})*	**Source**
Tributary 2	1,800	730	1,800	Permitted
Brushy Fork	10,200	1,460	8,800	Permitted
Legget	1,100	720	700	AML
Wash	400	1,100	1,100	AML
Mudlick	26,300	5,100	4,400	AML
(Mudlick Refuse)	(15,300)	(1,090)	(--)	AML
Bridge	40,200	3,250	3,300	AML
(Bridge Run Refuse)	(15,300)	(1,100)	(208)	AML
Tributary 1	3,600	1,150	3,250	unknown
Sauls	2,900	400	1,800	unknown
Others	-17,200	-4,400	8,750	in-stream processes
Fink Run at Mouth	69,300	9,500	33,900	

A.3.b. Sediment

<u>Sediment from Agriculture</u>

Approximately 37% of the watershed land is under agricultural use (Table 1) and 73% of that area is used as pasture (WV DEP 2000). Visual inspection of several farms shows the potential for erosion and sediment influx to streams due to lack of riparian buffer zones and lack of streamside fences. Furthermore, most of the farms are located in the flat floodplain adjacent to streams.

In June 2004 The Highlands Institute conducted an intensive survey of stream habitat quality in Fink Run watershed. The Rapid Habitat Assessment (RHA) metric was used as an indicator of habitat quality for fish and macroinvertebrates and as a method for evaluating riparian zone adequacy (WV SOS 2004). The RHA score is the sum of 12 parameters and ranges from 12 to 240 (12-60, poor; 61-120, marginal; 121-180, sub-optimal; 181-240, optimal). Each parameter ranges in value from 1 to 20 (1-5, poor; 6-10, marginal; 11-15, sub-optimal; 16-20, optimal).

A total of 18.8 miles or 71% of the total stream miles in Fink Run were assessed with the RHA metric. The majority of streams, 54%, were categorized as poor to marginal in terms of embeddedness indicating that erosion and sedimentation are widespread (Table 9). High levels of embeddedness may also be symptomatic of acid mine drainage; however, the characteristic orange color of AMD precipitates were rare.

In terms of Bank Vegetative Condition and Bank Condition a minority of stream miles were in the marginal and poor categories (21.5% and 15.5%, respectively). Most stream reaches were classified as sub-optimal meaning that minimal vegetative cover was present but small patches of stream bank were bare or disturbed and therefore susceptible to erosion. Less than 1% of stream reaches had optimal scores for Bank Condition (Figure 5).

Riparian Zone scores fell mostly in the poor and marginal categories (88.3%). This suggests that most Riparian Zones were less than 20 feet wide and/or had sparse or low-growing ground cover (Figure 6).

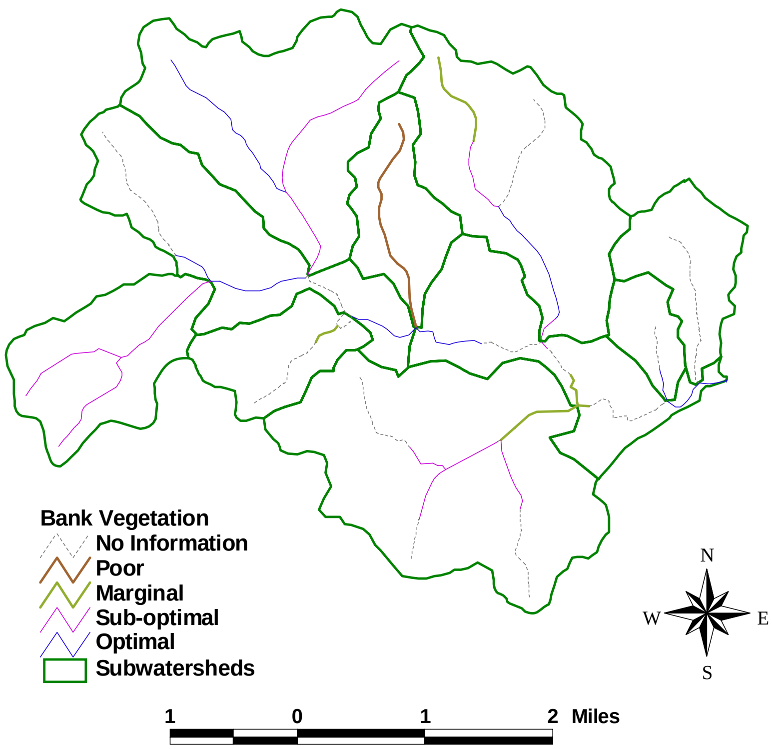
The Total RHA scores for Fink Run streams were predominantly in the sub-optimal category (75%). There were no streams that qualified as optimal. About 23% of streams fell within the marginal category and about 2% within the poor category (Figure 6).

In summary, no more than 25% of the streams in Fink Run watershed fell within the optimal category for any of the parameters listed here. The high percentage of streams with marginal or poor bank and riparian zone conditions are likely to be sources of sediment during storm events. If that is the case, then it is possible to estimate the number of miles of stream within the watershed that are contributing sediment to streams. Approximately 21.5% of stream miles or 5.6 miles have impaired bank conditions and 88.3% or 22.9 miles have inadequate riparian zones. Figures 5 and 6 show the specific stream reaches that need reclamation.

Table 9. RHA scores for 76 stream reaches (18.8 miles) in Fink Run watershed in 2004. Values within each row represent the percentage of the assessed stream miles that fell into that category.

Parameter	**Optimal**	**Sub-Optimal**	**Marginal**	**Poor**
Embeddedness [a]	17.4%	28.0%	13.7%	40.9%
Bank Vegetative Conditions [b]	24.7%	53.8%	9.9%	11.6%
Bank Conditions [c]	0.2%	84.3%	10.9%	4.6%
Riparian Zone [d]	6.7%	5.0%	22.7%	65.6%
Total RHA Score [e]	0.0%	75.1%	22.9%	2.0%

[a] Embeddedness = degree of siltation of stream bed; related to the amount of pore space available for oxygen transfer and for macroinvertebrate habitat.
[b] Bank Vegetative Conditions = degree of vegetative cover of stream banks
[c] Bank Conditions = degree of stream bank stability and erosion potential
[d] Riparian Zone = width and quality of riparian zone
[e] Total RHA Score = the sum of all 12 RHA parameters; overall habitat quality



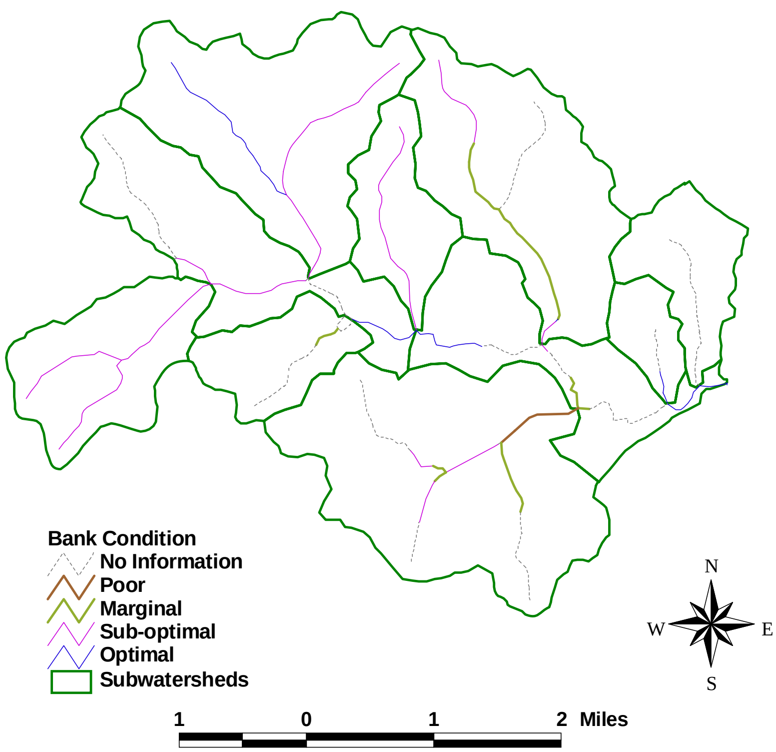


Figure 5. Maps of Fink Run streams showing the RHA scores for Bank Vegetation Condition (upper panel) and Bank Condition (lower panel) from an intensive survey in June 2004. Thick lines show poor and marginal categories.

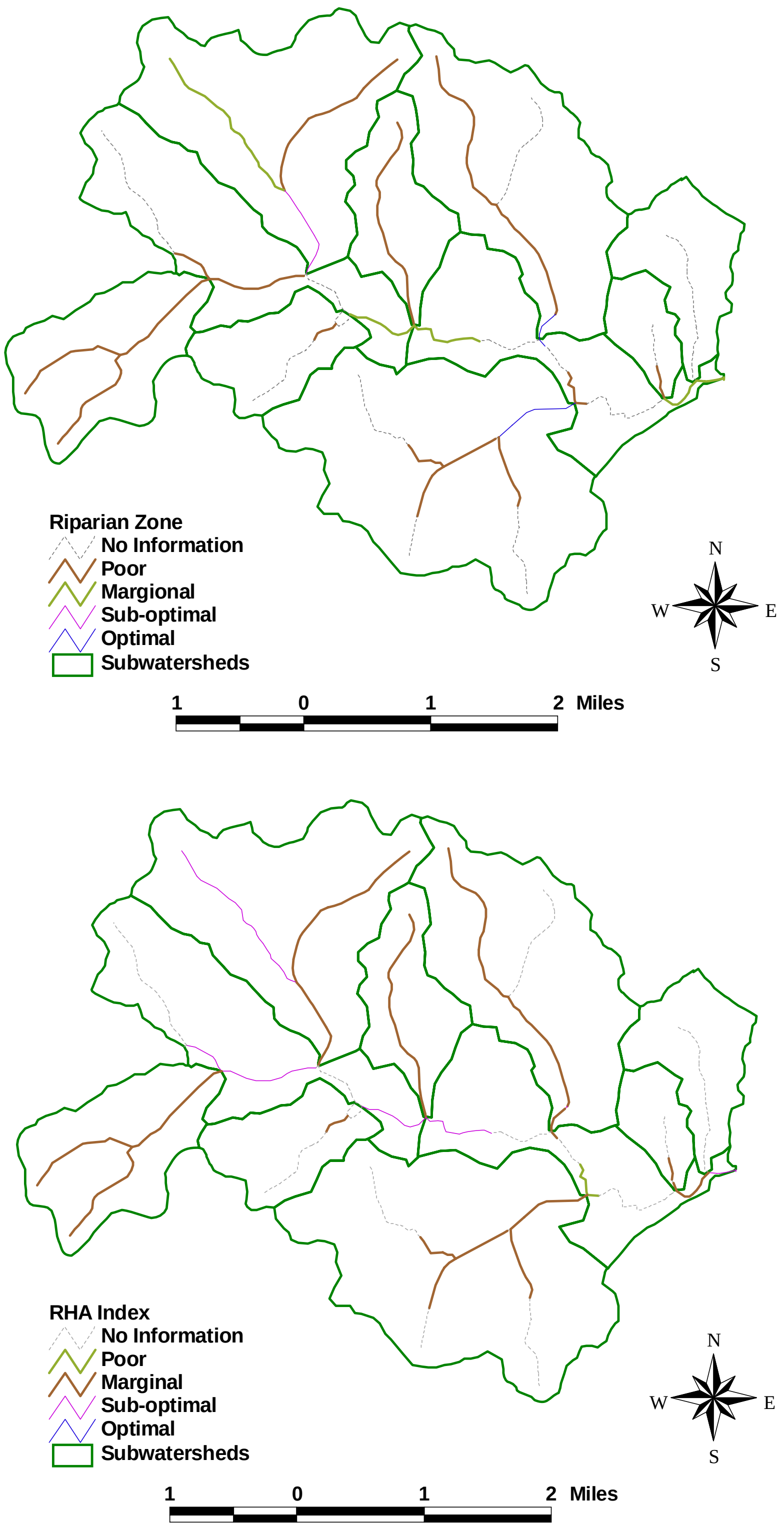


Figure 6. Map of Fink Run streams showing the RHA scores for Riparian Zone Condition (upper panel) and the overall RHA Index from an intensive survey in June 2004. Thick lines represent the poor and marginal categories.

Sediment from Forestry

The Fink Run watershed is about 59% forested with both deciduous and mixed forests common. In 2003, there were five logging operations registered with the WV Division of Forestry (Jim Hayes, personal communication) that encompassed 155 acres. The DOF estimates that about 8% or 12.4 acres was permanently disturbed (i.e., converted to road or landing). In addition about 100 acres was clearcut for airport expansion in Brushy Fork subwatershed. However, private landowners may have cut additional small amounts of timber on their land without reporting it.

Sediment from Oil and Gas Roads

There are approximately 172 oil and gas wells distributed fairly evenly within Fink watershed according to WV DEP GIS shape files (Figure 7). The status of these wells is described in Table 10. There is tremendous erosion potential from these widespread sources. Within the Buckhannon River Watershed approximately 0.3 miles of access road is associated with each well according to the WV Office of Oil and Gas. Therefore, there should be approximately 51 miles of oil and gas roads for the 172 wells in Fink Run watershed.

Table 10. Status of oil and gas wells within the Fink Run watershed in 1999 (WVDEP 2004).

STATUS	**# OF WELLS**
Unknown	8
Abandoned	30
Active	99
Future Use	4
Plugged	23
Total	**172**

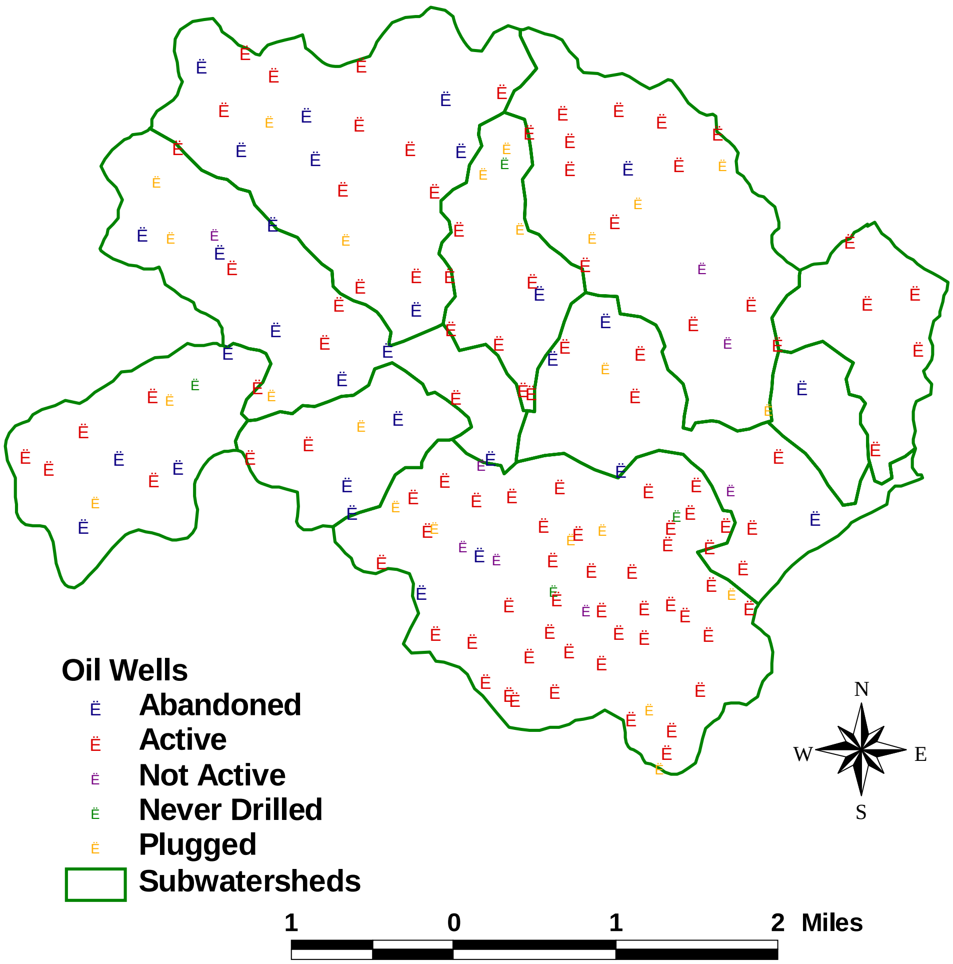


Figure 7. Map of Fink Run showing the location of the 172 oil and gas wells.

A.3.c. Habitat Quality

In 1997 WVDEP conducted an ecological assessment of the Tygart Valley River Watershed, which includes Fink Run watershed. Three streams were evaluated for biological integrity of using the WV Stream Condition Index (SCI) based on benthic macroinvertebrate counts. The SCI is a combination of six different metrics that assess the diversity and abundance of macroinvertebrate populations. The scale ranges from 0 to 100 with categories of Impaired (0 to 61), Gray Zone (61 to 68), and Good (68 to 100). The three stream sections had an average score of 31.3 (on a scale of 0 to 100) which is well below the "gray zone" in the "Impaired" category. The highest score was 43.8 (Good) and the lowest was 21.4 (Table 11). All three streams were considered impaired by this metric (Table 11).

Rapid Habitat Assessment was also performed on approximately 18 miles of streams in Fink Run watershed in 2004 (see Table 9 and Figures 5 and 6).

Table 11. Habitat and biological assessment of Fink Run watershed. Bold values indicate WVSCI scores < 61 (impaired) or Habitat Scores less than 120 (poor to marginal). Source: WVDEP (2000).

Stream Name	Subwatershed	WVSCI
Fink Run	Lower Fink	**43.8**
Mudlick	Mudlick	**21.4**
Wash	Wash	**28.8**
Average		**31.3**

A.3.d. Fecal Bacteria

A modest amount of bacterial data are available for Fink Run watershed. The Watershed Assessment Program sampled three locations in 1997. The Stream Restoration Group (WVDEP) made a sweep of the watershed in May 2002, sampling 15 locations. The Highlands Institute collected the most recent samples from seven sites in 2004. All of these data are presented in Table 12. Every sampling site violated state water quality criteria on at least one occasion. A total of 16.1 miles, or 62% of stream miles in the watershed, are impaired by coliform.

An intensive sampling project at the mouth of Fink Run was carried out by the Buckhannon River Watershed Association in April 2004. Five samples were collected during the month and yielded a geometric mean of 551 CFU per 100 mL. The values ranged from 84 to >6,000 CFU per 100 mL.

Table 12. Fecal coliform concentrations (CFU per 100 mL) in Fink Run and its tributaries on three different sampling dates. Streams with an asterisk violated state water quality on at least one of the dates.

			Collection Date		
Description	**Subshed**	**Stream Miles**	**1997**	**May 2002**	**July 2004**
Fink Run near headwaters *	Upper Fink	0.7	--	900	--
Fink Run downstream of Bridge Run *	Upper Fink	0.3	--	270	1,900
Fink Run just below Sauls Run *	Upper Fink	1.0	--	--	2,040
Fink Run at mouth *	Lower Fink	4.1	270	70	2,585
Bridge Run at mouth *	Bridge	0.7	18	90	470
Bridge Run upstream of Unnamed Tributary 2 *	Bridge	0.7	--	340	--
Unnamed Tributary 2 of Bridge Run *	Bridge	1.1	--	320	--
Tributary 2 at mouth *	Trib 2	1.3	--	290	--
Wash Run at mouth *	Wash	0.6	3,100	210	2,380
Sauls Run near mouth *	Sauls	0.9	--	583	12,900
Unnamed Tributary 2 of Sauls Run near mouth *	Sauls	0.9	--	200	--
Mudlick Run at mouth *	Mudlick	1.3	17	20	4,540
Brushy Fork at mouth *	Brushy Fork	1.9	--	--	1,675
Legget Run at mouth *	Legget	0.6	--	--	5,200
Total Miles		**16.1**			

The large number of livestock farms situated adjacent to streams in which there are no fences to exclude cattle and minimal riparian zones (see Table 9) strongly suggests that cattle are the main source of coliform rather than straight-pipes or septic systems.

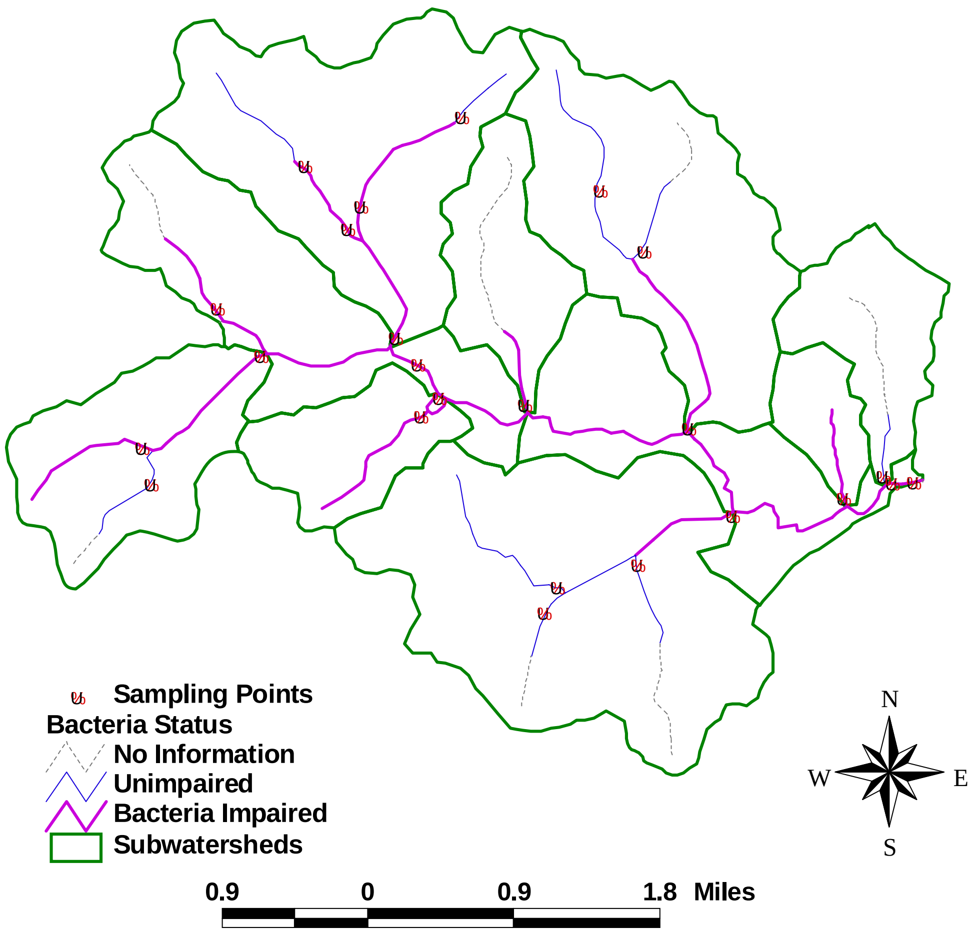


Figure 8. Illustration of streams impaired by fecal coliform bacteria. Streams in violet, bold lines violate state water quality criteria. Streams in thin, blue lines are in compliance. Dashed, gray lines represent streams with no information.

B. Load Reductions Expected

B.1. Metals

Project 1: Reclamation of the Mudlick Refuse area will lead to a reduction in metal concentrations and an increase in pH. If we assume that all metals will be removed by the project, then the load reductions will be equal to the existing loads from the Mudlick Refuse discharges which are 15,300 and 1,090 lbs yr^{-1} for iron and manganese, respectively (Table 8). This substantial reduction in iron (58%) could be enough to bring the stream into compliance.

Project 2: Reclamation of the Bridge Run Refuse area will lead to a reduction in metal concentrations and an increase in pH. If we assume that all metals will be removed by the project, then the load reductions will be equal to the existing loads from the Bridge Run Refuse discharges which are 15,300, 1,100 and 3,300 lbs yr^{-1} for iron, manganese, and aluminum, respectively (Table 8).

B.2. Sediment and Fecal Bacteria

Project 3: It is not possible to estimate reductions in sediment and fecal bacterial load in streams in Fink Run watershed. However, we can estimate the number of riparian zone miles that will be improved to the point where sediment inputs will be minimal. RHA scores indicate that about 22 miles of riparian zone are marginal or poor and 5.6 miles have marginal or poor bank conditions.

Implementation of agriculture BMPs will restore approximately 5 miles of stream banks and riparian zones which will lead to a reduction in impaired riparian zone miles of 23% and a reduction in unstable stream banks of 89%.

C. Non-point Source Management Measures

C.1. Project 1: Mudlick Refuse Reclamation

Mudlick Run was the site of an Abandoned Mine Lands reclamation project in 1988. However, the stream still shows signs of AMD contamination (Table 4). The WV Office of Abandoned Mine Lands and Reclamation has proposed a second reclamation project in Mudlick subwatershed at the site of an old coal refuse pile. The project will include capping the pile with one foot of topsoil to prevent erosion and water infiltration and installing 1,520 feet of limestone channels to increase the pH. Along the channels trees will be planted to establish a riparian zone. AML funds may be used for this project as well as 319 funds and funding from other sources.

C.2. Project 2: Bridge Run Refuse Reclamation

The WV Office of Abandoned Mine Lands and Reclamation recently completed a project in Bridge Run subwatershed to eliminate sediment from an old deep mine. AMD is still being discharged from the site (see Table 8) for unknown reasons. A pilot project is in the design phase to decrease metal concentrations and increase pH by injecting soybean oil into underground wells. This is an experimental treatment that has not been used for AMD treatment before. The engineering firm from NC that will be testing this technique will cover most of the costs of the project. The only cost to the Office of AML&R is stream monitoring and drilling of the injection wells. The cost estimate to reclaim this site using conventional means was approximately $100,000.

C.3. Project 3: Implementation of Agriculture Best Management Practices

Sediment and fecal bacteria reduction within an agricultural operation can best be achieved by the implementation of Best Management Practices or BMPs. These BMPs are designed and established to help reduce the delivery of agricultural nonpoint source pollution to state waters. A second benefit to the implementation of BMPs is that they can make a farmer’s agricultural operation run more efficiently saving time and money. A few BMPs that reduce sediment and bacterial inputs to streams include: rotational grazing, fencing, alternative water sources, stream crossings, buffer and filter strip, riparian area development, winter feeding areas, and roof run off management. These BMPs work to reduce water flow over bare ground, reduce the amount of bare ground, and encourage vegetative growth.

The WV Conservation Agency and the Natural Resources Conservation Service work with private landowners and farmers and encourage them to implement BMPs on their land through a series of incentive, education, and technical assistance programs. Two funding sources for these programs currently are EQUIP and CLEP programs. The WVCA and NRCS will also seek 319 funds to expand their ability to offer incentive programs and to offer a greater diversity of programs to landowners. WVCA estimates approximately 5 miles of streams and riparian zones in Pecks Run watershed will be improved by this project.

C.4. Project 4: Coordination and Education

Because of the multi-agency cooperation needed for efficient non-point source reclamation efforts, this plan would not be complete without a strategic plan for coordination and education. The Buckhannon Framework Steering Committee (BFSC) is a multi-organizational body that includes representatives from state, federal, and county agencies, non-profit interest groups, and business and is facilitated by Jennifer Pauer of the WV DEP. This makes it an ideal coordinating body for the watershed-based implementation plan.

A subcommittee of this group will be responsible for disseminating this plan to the BFSC, monitoring the progress of all non-point source projects, making annual reports to the BFSC, ensuring that monitoring is performed on schedule, gathering and storing monitoring data and other data, and revising the WIP as scheduled. The subcommittee will consist of at least four members of the BFSC including at least one Non-Point Source Specialist from the WV DEP and at least one representative of the Buckhannon River Watershed Association.

In order to evaluate the progress of implementation projects and to ensure that proper monitoring is conducted, a biennial Progress Report will be written by the subcommittee and submitted to the BFSC. The Highlands Institute for Environmental Research and Education has agreed to serve as the central repository for data.

The subcommittee will work with the Buckhannon River Watershed Association, The Highlands Institute for Research and Education, WV Conservation Agency, WV Division of Forestry, and WV Office of Oil and Gas to implement education and outreach objectives and to assess their effectiveness.

Monitoring for metals, sediment, and bacteria and periodic bioassessments require the coordination of several state agencies and other organizations (see section I). The subcommittee and the BFSC will be the coordinating bodies to avoid duplication of efforts and to ensure monitoring occurs on schedule. Benthic macroinvertebrate data, in particular, are lacking so collecting this information will be a high priority in the first few years.

Finally, in order to be able to calculate existing loads more accurately and to make predictions about load reductions, a simple hydrologic model of the watershed needs to be developed. Such a model will simulate water flow in the river mainstem as well as in major tributaries and be simple enough for the subcommittee to employ. There are several models available that could be adapted to the Fink Run watershed. One is BASINS which is available from EPA. Another is being developed by Dr. Bruce Edinger at Salem International University in West Virginia.

All of the above activities will require a modest amount of resources that will be obtained through grant funding, in-kind matches (e.g., citizen volunteers), and state and federal operating expenses (i.e., employee time). There are many funding opportunities available for environmental education projects through the federal government (like EPA) and private foundations like SURDNA.

D. Financial and Technical Assistance Required for Implementation

D.1. Project 1: Mudlick Refuse Reclamation

Installation of limestone channels (1,520 ft.)	$181,025
Installation of riparian zone	$ 30,000
Covering coal refuse	$ 90,000
Project 1 Total:	**$301,025**

Technical Assistance
WV Office of Abandoned Mine Lands and Reclamation
WV Division of Water and Wastewater
WV Division of Natural Resources

D.2. Project 2: Bridge Run Refuse Reclamation

[The engineering firm from NC will be responsible for all other costs for this experimental project.]

Drilling injection wells	$ 20,000
Project 2 Total:	**$ 20,000**

Technical Assistance
WV Office of Abandoned Mine Lands and Reclamation
WV Division of Water and Wastewater
WV Division of Natural Resources

D.3. Project 3: Implementation of Agriculture Best Management Practices

Fencing	$ 5,000
Critical Area Treatment	$ 3,000
Stream Crossing	$ 2,000
Water Supply	$ 8,700
Roofed Winter Feeding Areas	$ 27,000
Heavy Use Protection Area	$ 2,600
Roof run-off management	$ 1,300
Buffer and filter Strips	$ 1,000
Animal Waste Storage Facilities	$ 15,000
Habitat Assessment and Biological Monitoring	$ 3,300
Administrative Costs	$ 11,713
Project 3 Total:	**$ 80,613**

Technical Assistance
WV Conservation Agency
USDA Natural Resource Conservation Service
Buckhannon River Watershed Association
WV Save Our Streams

D.4. Project 4: Coordination and Education

Implementation of Education Projects	$ 4,000
Writing two Progress Reports	$10,000
Revising the WIP	$ 8,000
Developing hydrologic model	$ 6,000
Project 4 Total:	**$28,000**

Technical Assistance
The Highlands Institute
Buckhannon River Watershed Association
WV Division of Water and Wastewater
Buckhannon Framework Steering Committee

Table 13. Grand total for all four proposed projects.

	Estimated Costs
Project 1	**$ 301,025**
Project 2	**$ 20,000**
Project 3	**$ 80,613**
Project 4	**$ 28,000**
Grand Total	**$ 429,638**

E. Information and Education Component

E.1. Acid Mine Drainage

"Education" is featured prominently in the mission statements of both the Buckhannon River Watershed Association and the Highlands Institute for Environmental Research and Education at WVWC. These two organizations have a history of outreach and education in the local community and make use of a variety of media. The BRWA will keep local citizens informed through its newsletter, pubic forums, and educational displays at regional fairs and festivals. BRWA may also organize volunteer citizen monitoring of some of the AMD projects proposed herein. The Highlands Institute will convene meetings with state, county, and local agencies and facilitate communication among all participants.

E.2. Agriculture

Educating the agricultural community can bring about change. Through educational activities, workshops, and technical assistance landowners will be offered education concerning sediment, water quality, best management practices, as well as their surrounding environment. Technical assistance will be given to landowners who have questions or concerns about their agricultural operation. The Natural Resource Conservation Service and WV Conservation Agency will also promote their cost share programs (EQUIP, CREP, and 319) from which both farmers and the environment can benefit. News releases and brochures will be used as methods to inform the public of upcoming events, and programs that are available to them.

E.3. Forestry

The West Virginia Division of Forestry holds several workshops each year for their staff and for loggers within the state. Workshops are held to certify loggers and timber operators. These workshops are designed to educate loggers and operators about our environment and Best Management Practices to use while harvesting timber. Landowners who use a properly licensed timber operator <u>and</u> a certified logger know the workers will use BMPs that reduce both soil erosion and water pollution.

E.4. Oil and Gas

Educating the public about the use of oil and gas roads and pipelines as ATV roads is critical. Educational workshops, news articles, and demonstration projects to deter riders from these areas are key to their improvement. Oil and gas roads used by logging operations that are not brought back to original specifications also pose a problem. An education program used to train loggers will be implemented in connection with the WV Division of Forestry on how to bring them back to DEP standards.

F. Schedule of Implementation

Year	Qtr.	Project 1	Project 2	Project 3	Project 4
2004	3rd	pre-monitoring		obtain funding	
	4th		project design		
2005	1st				
	2nd		pre-monitoring;	implement program; pre- and post-monitoring on a per project basis; install BMPs	Implement Education programs
	3rd	project installation			
	4th				Develop hydrologic model
2006	1st				
	2nd	post-monitoring	project installation		write progress report
	3rd				Implement Education programs
	4th				
2007	1st				
	2nd		post-monitoring		Implement Education programs
	3rd				
	4th			final post- monitoring	
2008	1st				
	2nd				write progress report
	3rd				
	4th				
2009					revise WIP

G. Schedule of Interim Milestones

The first major milestone is in the middle of 2006 when this watershed-based plan will be revised or amended using information gathered in 2004 and 2005. Specifically, information collected for project 3 will provide the site-specific information needed to identify sources of pollution and to calculate loads and load reduction targets for sediment and fecal bacteria. Once the WIP is revised or amended, then funding from the Section 319 program will be sought to implement restoration projects.

The second milestone will in 2008 at which time the proposed projects will be complete (except perhaps for some post-monitoring). The success at achieving the targeted load reductions will be evaluated at that point. If the expected load reductions are not achieved, then additional reclamation projects will be designed.

H. Criteria to be Used

H.1. Metals

Concentrations and loads of iron, manganese, and aluminum will be used as the criteria. Loads will be calculated using a computer model (see sections I and C.5.) and measured metal concentrations. The targeted load reductions for Projects 1 and 2 are 30,600, 2,190, and 3,300 lbs yr^{-1} for iron, manganese, and aluminum, respectively. These load reductions correspond to

44%, 23%, and 10% of the iron, manganese, and aluminum in Fink Run. Success at achieving these reductions will be determined in 2008.

H.2. Sediment and Fecal Bacteria

Because it is difficult to measure sediment and bacteria loads directly, we will make use of indirect measures of sediment. The Rapid Habitat Assessment Index will be used to quantify stream channel and riparian zone quality and locations of BMPs that are installed will be recorded. Project 3 is predicted to restore 5 miles of stream channel (23% of the impaired stream miles) to an RHA Index of > 180. Whether or not that target is achieved will be assessed in 2008.

H.3. Biological Integrity

Bioassessment of benthic macroinvertebrates will be used to supplement the criteria listed above because periodic chemical sampling of specific pollutants may not provide a complete and accurate description of water quality. The WV Stream Condition Index will be used as the criterion for assessment. Values greater than 68% (Good category) are desirable. Streams will be assessed for this criterion in 2008.

I. Monitoring Component

Monitoring is an essential component of a watershed-based implementation plan because it allows stakeholders to see what progress is being made and when goals are achieved. Monitoring will be a key component of each of the projects described in section C above. In general at least one year of chemical monitoring will be conducted before and after each project within the project's subwatershed (see section F). Habitat assessment and bioassessment will be conducted once before and one year after the completion of each project. Chemical sampling will be the responsibility of the organization that is conducting the reclamation. Habitat and bioassessment may be done by the reclaiming organization or by WV Save Our Streams or The Highlands Institute.

In addition to localized, project-related monitoring, watershed-wide surveys of water quality will take place at least every two years and will include all of the criteria listed in section H. These surveys may be conducted by WV DEP, BRWA, or The Highlands Institute. The WV DEP is already planning a watershed-wide sampling for TMDL development in 2005.

J. References

Simmons, J.A. 2003. The Buckhannon River Watershed: A Summary of Data – 2003. The Highlands Institute for Environmental Research and Education. Buckhannon, WV.

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